# T07D01 – (7.2.(1-3)) ****Position of Equilibrium****

Name ……………………………………………………..

1. 7.2.1 Deduce the equilibrium constant expression (Kc) from the equation for a homogeneous reaction. (3)
   1. What is the general equation of an equilibrium constant, Kc? (AKA, the equilibrium law)
   2. For the production of ammonia (N2(g) + 3H2(g) ⇌ 2NH3(g)) @500oC, give the expression for Kc during each of the following experiments:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **[N2] mol dm-1** | **[H2] mol dm-1** | **[NH3] mol dm-1** |
| Exp. 1 | 0.992 | 0.763 | 0.157 |
| Exp. 2 | 0.299 | 1.197 | 0.203 |
| Exp. 3 | 2.59 | 2.77 | 1.82 |

* 1. Show the equilibrium equation and equilibrium constant expression for both the forward and reverse reactions of the formation of HI(g) from its elements:
  2. What happens to the value of Kc when the reaction is reversed? How is one calculated from the other?
  3. Write the equilibrium expression for the following reactions
     1. 2SO2(g) + O2(g) ⇌ 2SO3(g)
     2. Fe3+(aq) + SCN-(aq) ⇌ [Fe(SCN)]2+
     3. 4NH3(g) + 5O2(g) ⇌ 4NO(g) + 6H2O(g)
  4. The following reaction is an esterification reaction producing ethyl ethanoate:

CH3CO2H(l) + C2H5OH(l) ⇌ CH3CO2C2H5(l) + H2O(l)

The value of Kc for this reaction is 4.0 @ 25oC

1. 7.2.2 Deduce the extent of a reaction from the magnitude of the equilibrium constant. (3)
   1. How does the magnitude of Kc for the production of hydrogen halides of Cl and I compare? State how the magnitude of Kc sets the equilibrium in general:
   2. What are the relative values of Kc?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Kc < 10-10** | **Kc = 0.01** | **Kc = 1** | **Kc = 100** | **Kc > 1010** |
|  |  |  |  |  |

* 1. What is Kc NOT altered by?
  2. For the equilibrium between potassium (IV) chromate and potassium (IV) dichromate the equation is

2CrO42-(aq) + H+(aq) ⇌ Cr2O72-(aq) + OH-(aq)

state the equilibrium expression and explain how we can study this reaction:

1. 7.2.3 Apply Le Chatelier’s principle to predict the qualitative effects of changes of temperature, pressure and concentration on the position of equilibrium and on the value of the equilibrium constant. (2)
   1. State Le Chatelier’s Principle (you do not need to memorize this):
   2. What does this principle really mean?
   3. What are the effects on the position of equilibrium and the value of Kc when the following changes in environment take place?

|  |  |  |
| --- | --- | --- |
| **Change Made** | **Effect on position of equilibrium** | **Value of Kc** |
| **[conc] is changed** |  |  |
| **Pressure** |  |  |
| **Temperature** |  |  |
| **Catalyst** |  |  |

* 1. For the esterification reaction of

CH3CO2H(l) + C2H5OH(l) ⇌ CH3CO2C2H5(l) + H2O(l)

Explain what happens when water is removed to the reaction at equilibrium:

* 1. The production of Ammonia is very important, what happens when the concentration of N2 is changed?

|  |  |
| --- | --- |
| **Equilibrium Reaction** | **When Excess N2 is added** |
|  |  |

* 1. In general, what happens when the [reactant] or [product] is increased?
  2. Explain how Le Chatelier’s principle accounts for a change in pressure (due to volume change):
  3. When dinitrogen tetroxide is decomposed the reaction is as follows:

N2O4(g) ⇌ 2NO2(g)

Explain what happens when a change in pressure occurs and how it can be monitored:

* 1. What happens to equilibrium when the temperature is changed, and why?
  2. For the same reaction of the decomposition of dinitrogen tetroxide:

N2O4(g) ⇌ 2NO2(g)

How does the change in temperature effect the equilibrium, and how can it be monitored:

* 1. The effect of temperature on the equilibrium is dependent on the enthalpy of reaction, complete the following table to show the relative changes:

|  |  |  |  |
| --- | --- | --- | --- |
| **Nature of forward reaction** | **Change in Temperature** | **Shift in the position of equilibrium** | **Effect on value of Kc** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Next class:

1. 7.2.4 State and explain the effect of a catalyst on an equilibrium reaction. (3)
2. 7.2.5 Apply the concepts of kinetics and equilibrium to industrial processes. (2)